CLAIMS

What Is Claimed Is:

1. A polymer-based mirror, comprising:

a transparent synthetic resin substrate having an anterior surface and a posterior surface;

a tie-bond layer formed on said anterior surface and said posterior surface of said synthetic resin substrate;

a multi-layer surface-hardening coating formed by a single wet coating cured adjacent to said tie-bond layer on said anterior surface and said posterior surface of said synthetic resin substrate;

a reflective coating formed adjacent to one of said tie-bond layer on said posterior surface of said synthetic resin substrate and said surface-hardening coating; and

a protective back-coat layer formed as an outer posterior surface of said mirror.

2. The polymer-based mirror of Claim 1, wherein the multi-layer surface-hardening coating has varying amounts of $Z_v(iPv)_2$ and SiO_2 from anterior substrate surface to an exterior surface of the surface-hardening coating.

3. The polymer-based mirror of Claim 1, wherein three layers are provided in the surface-hardening coating with a first layer including the exterior surface having a zirconia/silica colloid concentration of approximately 75% by weight.

4. The polymer-based mirror of Claim 3, wherein a second layer adjacent the first layer has approximately 10% by weight zirconia/silica colloid concentration.

5. The polymer-based mirror of Claim 4, wherein a third layer adjacent the tie-bond layer has approximately 15% by weight zirconia/silica colloid concentration.

6. The polymer-based mirror of Claim 5, wherein the tie-bond layer is cathodic chemabsorbed zirconia/silica formed in the single wet coating.

7. The polymer-based mirror of Claim 5, wherein the reflective coating is multi-layered.

8. The polymer-based mirror of Claim 5, wherein a total thickness of the three layers is between 3 and 10 microns.

9. The polymer-based mirror of Claim 1, wherein the multi-layer surface-hardening coating has an exterior surface of cathodic zirconia/silica colloids to provide a hydrophobic coating.

10. The polymer-based mirror of Claim 1, wherein the multi-layer surface-hardening coating has an exterior surface of anodic zirconia/silica colloids to provide a hydrophilic coating.

11. The polymer-based mirror of Claim 1, wherein the multi-layer surface-hardening coating has an exterior surface that is enabled to be one of hydrophobic and hydrophilic depending on an applied pH level to the exterior surface.

12. A method of forming a polymer-based mirror comprising the steps of:

providing a synthetic resin substrate of a pre-determined configuration;

preparing a liquid sol-gel having a predetermined precursor concentration of zirconia/silica colloid particles;

applying a liquid sol-gel having a predetermined precursor concentration of zirconia/silica colloid particles to the synthetic resin substrate until a pre-determined thickness is provided;

permitting the zirconia/silica colloid particles to migrate and orientate in the liquid sol-gel to enable a subsequent formation of an abrasion resistant exterior coating;

curing the liquid sol-gel to form a solid abrasion resistant exterior coating;

applying a reflective layer to one side of the coated synthetic resin substrate; and

sealing the reflective layer.

13. The method of Claim 12 wherein the liquid sol-gel includes a polysiloxane carrier.

14. The method of Claim 13 wherein the precursor zirconia/silica forms an approximately 75% concentration by weight adjacent an exterior surface as a first layer.

15. The method of Claim 14 wherein a second layer of zirconia/silica forms an approximately 10% concentration by weight adjacent the first layer.

16. The method of Claim 15 wherein a third layer of zirconia/silica forms an approximately 15% concentration by weight between the second layer and the synthetic resin substrate.

17. The method of Claim 16 wherein a cathodic chemabsorbed zirconia/silica layer is formed between the third layer and the synthetic resin substrate.

18. The method of Claim 12 further including applying a predetermined pH liquid solution to the exterior coating to form one of a hydrophobic and a hydrophilic surface by causing the zirconia/silica particles to be one of cathodic and anodic.

19. The method of Claim 18 further including applying an aqueous solution of approximately 20 percent by weight NaOH to the exterior coating to form a hydrophilic surface.

20. The method of Claim 12 wherein in the step of preparing a liquid sol-gel, the following sub-steps are performed comprising:

mixing a partial hydrolysis of tetraethoxysilane with a solution including ZrO_2 percursor to consume all of the water to provide a ZrO_2 doped SiO_2 solution; and

dispersing the ZrO_2 doped SiO_2 solution in a polysiloxane liquid carrier.

21. The method of Claim 12 wherein in the step of preparing a liquid sol-gel, the following sub-steps are performed comprising:

mixing a full hydrolysis of tetramethoxysilane oligomer in water with a solution including a ZrO_2 percursor in a polar solvent to provide an anatose-type ZrO_2; and

dispersing the anatase-type ZrO_2 solution in a polysiloxane liquid carrier.

22. The method of Claim 12 wherein in the step of preparing a liquid sol-gel, the following sub-steps are performed comprising:

mixing sodium metasalicate with water at a balanced pH of 1;

adding zirconyl chloride while stirring;

emulsifying the mixture in ethanol;

adding hexamethylenetetramine and urea;

filter and wash with ethanol to form an anatase ZrO_2 sol-gel; and

dispersing the anatase ZrO_2 sol-gel in a polysiloxane liquid carrier.

23. A polymer optical component comprising:

a synthetic resin substrate having a first surface; and

a gradient zone surface-hardening coating formed on the synthetic resin substrate having a higher concentration of zirconia/silica particles adjacent an exterior surface and a progressively lesser concentration of zirconia/silica particles between the exterior surface and the synthetic resin substrate, the zirconia/silica particles are one of a cathodic and anodic polarity while providing an abrasion resistant and water resistant coating.

24. The polymer optical component of Claim 23 wherein the first surface has a chemabsorbed cathodic layer of zirconia/silica.

25. The polymer optical component of Claim 24, wherein three layers are provided in the surface-hardening coating with a first layer including the exterior surface having a zirconia/silica particle concentration of approximately 75% by weight, a second layer adjacent the first layer having a zirconia/silica particle concentration of approximately 10% by weight and a third layer adjacent the synthetic resin substrate having a zirconia/silica particle concentration of approximately 15% by weight.

26. The polymer optical component of Claim 25 wherein the synthetic resin substrate is transparent and a multi-layered reflective coating is provided adjacent a second surface of the synthetic resin substrate to provide a mirror.